

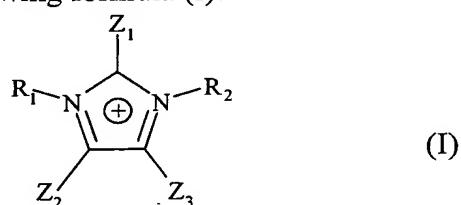
CLAIMS

5 1. Process for the preparation of an ion-conducting gel in solid form, also
designated "ionogel", characterized in that it comprises a stage of mixing an ionic liquid
with at least one molecular precursor comprising at least one hydrolyzable group, and if
appropriate, in the presence of an acid, such as a carboxylic acid, the mixture then being
left to stand for one or more days until a gel is obtained, formed by polycondensation of
the molecular precursor(s), containing within it the abovementioned ionic liquid, and
capable of being shaped, in particular in the form of transparent monolithic solid.

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15 2. Process according to claim 1, characterized in that the ionic liquid is chosen
from those comprising as cation an imidazolium or pyridinium nucleus, if appropriate
substituted, in particular by one or more alkyl groups with 1 to 4 carbon atoms.

20 3. Process according to claim 1 or 2, characterized in that the cation is an
imidazolium nucleus of the following formula (I):

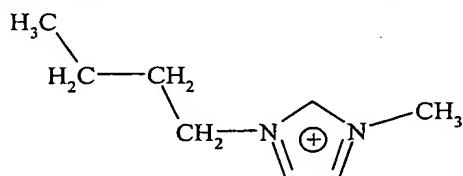


25 in which:

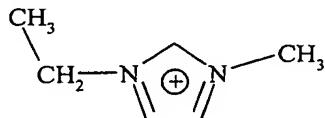
- R₁ and R₂ represent an alkyl group with 1 to 4 carbon atoms, and
- Z₁, Z₂ and Z₃ represent a hydrogen atom or an alkyl group with 1 to 4 carbon atoms.

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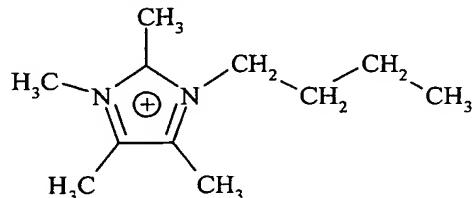
4. Process according to one of claims 1 to 3, characterized in that the cation is:
- 1-butyl-3-methylimidazolium of the following formula:



— or 1-ethyl-3-methylimidazolium of the following formula:



5 — or 1-butyl-2, 3, 4, 5-tetramethylimidazolium of the following formula:



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5. Process according to claim 1 or 2, characterized in that the cation is a pyridinium nucleus of the following formula (II):

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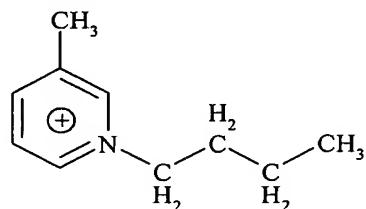
in which R₁ and R₂ represent a hydrogen atom or an alkyl group with 1 to 4 carbon atoms.

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6. Process according to one of claims 1, 2 and 5, characterized in that the cation is:

— 1-butyl-3-methylpyridinium of the following formula:

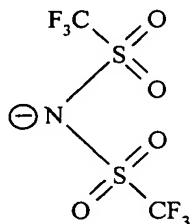
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7. Process according to one of claims 1 to 6, characterized in that the ionic liquid contains, as anions, those chosen from the halides and perfluorinated anions.

8. Process according to one of claims 1 to 7, characterized in that the anion is:
- bis(trifluoromethylsulphonyl)imide of formula:



- hexafluorophosphate of formula PF_6^- .

- 10 9. Process according to one of the claims 1 to 8, characterized in that the ionic liquid is chosen from:

- 1-butyl-3-methylimidazolium bis(trifluoromethylsulphonyl)imide,
- 1-ethyl-3-methylimidazolium bis(trifluoromethylsulphonyl)imide,
- 1-butyl-3-methylimidazolium hexafluorophosphate.

- 15 10. Process according to one of claims 1 to 9, characterized in that the molecular precursor is chosen from the derivatives of the elements of groups 13, 14 and 15 of the periodic table, or transition metal derivatives.

- 20 11. Process according to one of claims 1 to 10, characterized in that the molecular precursor is a compound of general formula: $\text{R}'_x(\text{RO})_{4-x}\text{Si}$

in which:

- x is an integer varying from 0 to 4,
- R represents an alkyl group with 1 to 4 carbon atoms, and
- R' represents:
 - * an alkyl group comprising from 1 to 4 carbon atoms, or
 - * an aryl group comprising from 6 to 30 carbon atoms, or
 - * a halogen atom,

25 said compound being in particular tetramethoxysilane, methyltrimethoxysilane, phenyltriethoxysilane, or characterized in that the molecular precursor is a mixture of compounds as defined above.

12. Process according to one of claims 1 to 11, characterized in that the ionic liquid/molecular precursor molar ratio in the mixture is 1/2.

5 13. Process according to one of the claims 1 to 12, characterized in that the carboxylic acid is formic acid.

10 14. Process according to one of claims 1 to 13, characterized in that the molecular precursor/carboxylic acid molar ratio in the mixture is 1/50.

15 15. Process according to one of claims 1 to 14, characterized in that the mixture is left to stand for 7 to 9 days under ambient atmosphere and temperature.

15 16. Process according to one of claims 1 to 15, characterized in that the mixture is aged under ultrasound for 24 hours.

20 17. Process according to one of claims 1 to 16, characterized in that the ionogels obtained have the following characteristics:

- they are monolithic solids,
- they are stable up to temperatures of approximately 350°C,
- they are transparent,
- they are ionic conductors, their ionic conductivity being in particular comprised between approximately 10^{-4} and 10^{-3} S.cm⁻¹ at ambient temperature and between 10^{-2} and 10^{-1} at 230°C.

25 18. Ionogels as obtained by implementation of a process according to one of claims 1 to 17, said ionogels comprising an ionic liquid as defined in one of claims 1 to 9, confined within a continuous solid network formed from at least one molecular precursor as defined in one of claims 10 or 11.

30 19. Ionogels according to claim 18, characterized in that they have the characteristics defined in claim 17.

20. Ionogels according to claim 18 or 19, characterized by the presence of a continuous solid network.

21. Ionogels according to one of claims 18 to 20, characterized in that they have the following mechanical properties:

- 5 – a Young's modulus comprised between approximately 50 and approximately 100 MPa, in particular comprised between approximately 52 and approximately 75 MPa, and preferably with an average value equal to approximately 63 MPa, and
- 10 – a stress at break comprised between approximately 0.1 and approximately 1.5 MPa, in particular comprised between approximately 0.44 and approximately 1.31 MPa, and preferably with an average value equal to approximately 0.82 MPa.

22. Ionogels according to one of claims 18 to 21, characterized in that they are stable in aqueous medium.

15 23. Use of ionogels according to one of claims 18 to 22:

- 20 – as conducting materials, in particular within the framework of the preparation of accumulators, fuel cells, photovoltaic cells or electrochrome systems,
- as membranes for the implementation of separation processes for gases or liquids, or for electrodialysis,
- as stationary phase in chromatographic analysis.